NOTE TO PTO PERSONNEL:

THIS PATENT APPLICATION IS BEING

FILED WITH *SMALL ENTITY STATUS*

RECONFIGURABLE BARRIER SYSTEM

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The subject reconfigurable barrier system is generally directed to a structure that may be temporarily erected to protect particular property, or delineated areas, against the destructive entry of unwanted elements such as rising flood waters. More specifically, the reconfigurable barrier system is a system having structural components which may be modularly assembled to quickly and conveniently erect a barrier structure that is highly secure and stable yet adaptable in configuration to the particular property being protected.

Threats to property are encountered in many forms, from many sources. Some of the most pervasive are found in rising waters due, for instance, to torrential downpours, rapid thawing, and infrastructure failures. Often, such threats arise rapidly and without significant warning, affording little opportunity to erect sufficient barriers in anticipation. This is particularly so in certain geographic regions and low lying areas where combinations of climate, elevation, and geo-terrestrial proximities conspire to realize the threats with much frequency.

In certain cases, permanent measures may be employed to guard persistently against these threats. Such permanent measures, however, tend not only to be aesthetically displeasing, but invariably restrict the properties' productive uses. Consequently, they are not available as viable options in most

cases. They certainly are not viable options in most residential applications, for example. There is therefore widespread need for a barrier system which may be temporarily though effectively erected responsive to the occurrence of certain calamitous situations.

Presently, in the event of rapidly rising waters due to torrential downpours or other calamities, a temporary dike is typically erected about the given property to keep it from being even partially immersed in the rising waters until the waters recede. Perhaps the most common approach heretofore known is to simply erect a temporary barrier by stacking individual sand bags. While reasonably effective as a water barrier, this approach is plagued by numerous practical drawbacks.

Among the most notable and obvious of these drawbacks are the cumbersome bulk of the individual sand bags themselves and the great number of such sand bags typically required to build up barrier sections of even modest size. Factor in the fact that these many, heavy sand bags must be first transported to the property in question, unloaded, then stacked individually by hand; and, the approach proves to be extremely labor intensive, prohibitively so in many cases. It does not help that removing the sand bags once the water recedes may be even more labor-intensive given that many sand bags may be water-saturated and, therefore, heavier.

While heavy-lifting power equipment may be employed, doing so may prove prohibitive in cost for many applications. What is more, the prevailing conditions requiring the dike structure in the first place may simply not afford the safe use of such power equipment.

Availability of the sand bag approach is thus usually limited to cases where a small army of laborers are found to pool their efforts together and build the structure heavy bag by heavy bag. Where the requisite manpower is lacking, property otherwise protectable goes unprotected, and substantial property damage occurs unnecessarily.

PRIOR ART

Barrier systems are known in the art, as are various structural components usable in such systems. The best art known to Applicant includes U.S. Patents #6,293,523; #6,042,301; #6,443,655; #6,193,085; #6,202,368; #5,505,443; #5,944,060; #5,964,058; #5,509,457; #5,152,197; #5,439,201; #5,297,890; #5,785,447; #5,671,584; #4,525,953; #4,026,085; #4,292,776; #4,867,420; #4,899,991; #4,452,027; #3,494,596; #3,909,998; #2,763,048; #2,930,638; and, #830,437. There is no barrier system heretofore known which combines the degree of simplicity, security of coupling, and convenient reconfigurability realized by the subject reconfigurable barrier system.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a reconfigurable barrier system which may be quickly and conveniently assembled for use then disassembled for transport and storage.

It is another object of the present invention to provide a reconfigurable barrier system that is simple yet highly secure in its structure and intercoupling of components.

It is yet another object of the present invention to provide a reconfigurable barrier system that may be selectively configured about a particular property to keep therefrom potentially invasive elements such as rapidly rising waters.

It is still another object of the present invention to provide a reconfigurable barrier system having simple and reusable components that may be modularly assembled without undue physical exertion.

These and other objects are attained by the subject reconfigurable barrier system which generally includes a plurality of support units spaced one from the other and at least one retention unit supported to extend between a pair of the support units to define a barrier section. Each support unit is formed with at least one engagement section defining an elongate channel. The retention unit is substantially impervious to liquid, and includes a pair of opposed engagement portions, each of which slidably engages one channel of the support unit. An intermediate portion extends between the opposed pair of engagement portions, and a seal portion extends along a longitudinal edge of that intermediate portion.

In certain embodiments, the reconfigurable barrier system also includes a brace unit which engages and reinforces the support of at least one retention unit.

The brace unit is formed with a stabilizing member and a tie member extending therefrom to engage the retention unit. Also in certain embodiments, the reconfigurable barrier system includes a plurality of barrier sections joined one to the other to form an endlessly looped barrier configuration about the particular area to be protected.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram showing a preferred embodiment of the present invention in an exemplary application;

FIG. 2 is a perspective view, partially cutaway, of a preferred embodiment of the present invention, fully assembled;

FIG. 3A is an inner perspective view of a portion of the preferred embodiment of the present invention shown in FIG. 2;

FIG. 3B is an outer perspective view of the portion of the preferred embodiment of FIG. 3A;

FIG. 4 is a perspective view, partially cutaway, of another portion of the preferred embodiment of the present invention shown in FIG. 2;

FIG. 5 is a perspective view in isolation of yet another portion of the preferred embodiment of the present invention shown in FIG. 2;

FIG. 6 is a sectional view of the portion of the preferred embodiment of FIG. 5;

FIG. 6A is a sectional view in an alternate embodiment of the portion shown in FIG. 6;

FIG. 6B is a sectional view in yet another alternate embodiment of the portion shown in FIG. 6;

FIG. 7 is a side elevational view of an alternate embodiment of the portion of the present invention shown in FIGS. 5 and 6;

FIG. 8 is a perspective view, partially cutaway, of the alternate embodiment of the portion of the present invention of FIG. 7, showing a plurality of the portions joined together;

FIG. 9 is an alternate embodiment of still another portion of the present invention shown in FIG. 2;

FIG. 10A is a perspective view, partially cutaway, of a second alternate embodiment of the portion of the present invention shown in FIGS. 5 and 6; and,

FIG. 10B is an outer perspective view, partially cutaway, of an alternate embodiment of the portion of the present invention shown in FIGS. 3A and 3B.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1-2, there is shown one preferred embodiment of the subject reconfigurable barrier system 10 assembled for use in an exemplary application - as a temporary dike for a dwelling 1 and its immediate surroundings. In general concept, the temporary dike application shown for reconfigurable barrier system 10 may be quickly and conveniently erected when the need arises to include one or more barrier sections 15. Preferably, a plurality of barrier sections 15 are joined to define an endless barrier loop about the dwelling 1 and its grounds.

In accordance with the present invention, the number, size, and relative arrangements of barrier sections 15 may be readily varied to suit the particular needs of the given application. The closed loop configuration of barrier sections 15 illustrated in FIG. 1 affords a measure of self-support which enhances the system's overall ability to withstand the considerable pressure that may be applied against the barrier sections' outer sides by rising waters. Where the rising waters are expected to reach lesser levels, for example, the heights of certain barrier sections 15 may be (either uniformly or non-uniformly) lowered accordingly. The certain barrier sections 15 may likewise be formed with increased or reduced lengthwise spans, and the total number of sections 15 correspondingly reduced. Where the requirements of the intended application permit, barrier sections 15 may also be arranged in an open configuration about, perhaps, only a certain portion of the property being protected.

The need for temporary dikes often arises with little warning - with sudden downpours in low-lying areas; the cresting of rivers over their banks due to a

thaw following a season of unusually heavy precipitation; or, the failure of water containment and drainage systems, for example. It is an important aspect of the present invention that the components of reconfigurable barrier system 10 may be easily transported to the property in question for quick assembly and installation to erect a protective barrier that conforms to the shape and surface contour of that property; and that this may be accomplished without a great degree of manpower, and without necessitating the use of any special tools.

Barrier sections 15 serve to block the destructive entry of rising waters into the protected property, firmly and securely withstanding the weight of those waters. After the calamity has passed, and the waters have receded to safe levels, reconfigurable barrier system 10 may be quickly disassembled and transported away for storage, again without any great degree of manpower and without the any use of special tools.

As illustrated in FIG. 2, each barrier section 15 is defined by a pair of support units 100 spaced a suitable distance one from the other, and one or more retention units 200 supported by paired support units 100 to extend therebetween. System 10 further includes in the embodiment shown a brace unit 300 which engages an intermediate portion of one or more retention units 200 to reinforce the given barrier section's support. Support units 100 and brace units 300 are each preferably provided with structural measures for engaging in anchored manner the ground (or other surface) which underlies system 10 to stabilize and affix the given barrier section 15.

Each support unit 100 is formed with at least one engagement section 110 that defines an elongate, vertically extending channel. Preferably, each support

unit 100 includes a pair of such engagement sections 110 projecting laterally outward from an intermediate section 120 disposed therebetween. Engagement sections 110 of a common support unit 100 are configured to be offset from one another in angular orientation, such that an angled sectional contour results for that support unit 100. The paired engagement sections 110 may be offset by any angle suitable for the intended application.

A user preparing to erect a plurality of barrier sections 15 may have at his/her disposal a plurality of support units 100 of various angled profiles formed by their respective engagement sections 110. The user may then arrange suitable combinations of the variously angled support units 100 to effectively 'stake' out the barrier sections about the dwelling 1 or other property to be protected. Individual retention units 200 of sufficient length to span the space between two support units 100 may then be slidably coupled to the engagement sections 110 of those support units 100 to build up barrier sections 15 and develop a protective barrier system 10 encircling the property. Where, of course, the intended application does not require the given property to be fully encircled, the erected barrier system 10 may terminate at one or more support units 100. A dedicated support unit 100 formed perhaps with a single engagement section 110 and/or other structural variations (from that shown in FIG. 2) incorporated to aid its function as a stable end support may be employed in an alternate embodiment.

Preferably, each support unit 100 is formed with a base section 130 projecting transversely from the engagement and intermediate sections 110, 120. This base section 130 is preferably formed with one or more anchoring members 132 that securely engage the surface therebeneath. In the embodiment shown, a

portion of each base section 130 serves as a common mounting base for engagement and intermediate sections 110, 120 to augment the overall structural integrity of support unit 100. The remaining portions of base section 130 project transversely from engagement and intermediate sections 110, 120 to form a flanged load bearing platform. This platform provides a convenient point on which to step or otherwise apply a downward force on support unit 100 in driving the anchoring members 132 into the supporting surface underneath.

Where the supporting surface is not extremely hard (as with soil-based ground surfaces), it may be sufficient for the user simply to step on the flanged loading platform of base section 130 and allow his/her weight to drive anchoring members 132. In other cases, it may be necessary to apply a hammering or other impact force to adequately drive anchoring members 132 into the supporting surface. As such a forceful impact directly upon the top edges of engagement and intermediate sections 110, 120 may cause destructive deformation, the flanged loading platform of base section 130 provides a safe and convenient point of impact for such a driving force.

The transversely projecting base section 130 also serves the concurrent purpose of providing a spread contact surface for greater stability of support upon the supporting surface. Preferably, anchoring members 132 are driven far enough into the supporting surface that the bottom face of base section 130 makes substantially flush contact with that supporting surface. This guards against the tipping of the upright support unit 100.

It is to be understood that base section 130 may be configured in any suitable manner permitted by the intended application, and the configuration

shown in the FIGS. therefor is only exemplary. Base section 130 may be readily varied in its contour, relative dimensions, and precise positioning and orientation with respect to engagement and intermediate sections 110, 120. Hence, while anchor members 132 are formed in the embodiment shown as individual spikes, they may be formed with any other suitable configuration.

Anchor members 132 may be configured in certain alternate embodiments, for example, to collectively form an arrow-like structure having a crossed sectional contour. In certain other embodiments, base section 130 may be formed without integrally formed anchor members 132, having instead one or more openings formed therein to receive a spike or other extraneous securing member therethrough. In various other embodiments where the supporting surface is impenetrably hard or must be preserved without significant disturbance, anchor members 132 may be configured in any other suitable manner for securement to the supporting surface without driving into it.

It is important that each support unit 100 be of sufficient strength, rigidity, and durability to withstand repeated use in applications where considerable forces may be applied by rising waters, debris, high winds, and the like. Preferably, each support unit 100 is formed of a steel or other metallic material, fabricated and appropriately conditioned to resist corrosion using any suitable means known in the art. Where available, any other material of comparable strength, rigidity, and durability may be employed to form support units 100. The choice of particular material composition for support unit 100, as for any other component of the subject reconfigurable barrier system 10, is not essential to the present invention.

Referring now to FIGS. 3A-3B, the strength and rigidity of each support unit 100 may be further augmented by incorporating one or more angle braces 140 secured between opposing engagement sections 110. Each brace unit 140 guards against the buckling of engagement sections 110 when pressure is applied to the outer side of given barrier sections 15 by water, debris, or wind. Additionally, intermediate section 120 is preferably formed with an I-beam or other such construction to maximize its rigidity and strength.

As mentioned, each engagement section 110 defines an elongate channel 112 configured to snugly yet slidably receive an engagement portion of one or more retention units 200. Engagement section 110 may be dimensioned lengthwise (vertically) to accommodate as many edge-to-edge stacked retention units 200 as required by the intended application. Also, the retention units 200 which span the distance between two support units 100 may be of any suitable longitudinal length, and may be considerable in cases. Engagement section 110 of each support unit 100 is accordingly dimensioned in depth (horizontally) to maintain sufficiently secure engagement of the given retention unit(s) 200 despite their length. Some bowing of the retention units' intermediate portions will invariably occur, particularly for longer spans, when subjected to cross forces during use; and, the engagement of sections 110 and retention units 200 must be provided to withstand as much. In actual implementation, such factors as the rigidity of the engagement section panels, the rigidity of the retention unit engagement portions, the distance to be spanned by the engaged retention unit(s), and the magnitude and direction of the forces to be encountered during use will determine the actual dimensional configurations required.

With repeated use and handling, physical distortion of the elongate channels 112 of support unit engagement sections 110 is quite possible. A forceful blow or the overbearing weight of another component upon that engagement section 110 may cause sufficient deformation to disruptively compress the channel in width at one or more points, for instance. Appropriate measures like the use of a gap-plugging insert member in each engagement section's elongate channel 112 may be in order while a support unit 100 is held in storage (when its elongate channels remain disengaged from and therefore unoccupied by any retention units). Such other exemplary measures - like a rigid, handle-like outer bracing member fixedly coupled to extend externally between outer wall portions of each support unit's engagement sections 110 - may be employed to secure those outer wall portions from deflection inward into the elongate channel.

The arrangement of barrier sections 15 may be readily varied from the polygonal configuration illustrated in FIG. 1 by selectively setting one or both of two parameters: the angular profile of a support unit 100 shared by adjacent barrier sections 15 and the respective retention unit span lengths for barrier sections 15. Numerous different barrier section arrangements may be formulated by selecting different combinations of components to vary these parameters in the actual assembly and installation of the subject reconfigurable barrier system 10.

To provide lateral support for the intermediate portions of retention units 200 spanning the distance between corresponding support units 100, one or more brace units 300 may be employed in each barrier section 15. Each brace unit 300 includes an elongate stabilizing member 310 from which one or more tie

members 320 transversely extend to engage the intermediate portion of at least one retention unit 200. Preferably, stabilizing member 310 is formed with a pole portion 312 having a plurality of coupling holes 315 formed therealong. Tie member 320 is formed with a collar portion 322 which telescopically engages pole portion 312 of stabilizing member 310 for adjustable axial displacement along its length. Collar portion 322 is formed with diametrically opposed coupling holes 325 to receive a pin 324 or other fastening member when aligned with corresponding coupling holes 315 of stabilizing member pole portion 312. Tie member 320 is thereby locked in releasable manner at a selected position along stabilizing member 310.

Tie member 320 further includes an arm portion 324 extending radially from collar portion 322 toward the retention unit(s) 200 to be reinforced. This arm portion 324 is terminated preferably by a hook portion 326 which retentively engages an intermediate portion of the given retention unit(s) 200.. Hook portion 326 in the embodiment shown includes a pair of hooking elements 326a, 326b spaced from one another to engage a longitudinal edge of the retention unit 200. Preferably, each hooking element 326a, 326b extends both transversely upward and downward relative to arm portion 324 such that they may concurrently engage portions of both the upper and lower ones of a stacked pair of retention units 200, with the section of arm portion 324 connecting hooking elements 326a, 326b captured between the stacked retention units 200.

It may be advantageous in certain embodiments to position pole portion 312 to bear against and extend vertically across a barrier section's retention unit(s) 200. In that case, the need for a second hooking element 326a/b is

obviated, as the pole portion 312 may itself be sufficient to provide the required support against inward lateral deflection of the retention unit(s) 200. Only one of the hooking elements 326a/b shown would then be necessary to provide support against outward lateral deflection of such retention unit(s) 200. One or more suitably configured tie members 320 may be employed on pole portion 312 in accordance with such alternate embodiments.

While it serves to brace intermediate portions of retention units 200 against lateral deflection when subjected during use, for instance, to the weight of rising waters bearing against the outer surfaces of those retention units 200 - brace unit 300 serves also to support at least those retention units 200 under which arm portion 324 passes against vertical drooping or deflection. To ensure sufficient strength and rigidity, brace unit 300 is also preferably formed of a metallic or other material having comparable properties, galvanized or otherwise condition/treated to withstand extended periods of exposure to wet, extreme environmental conditions.

Pole portion 312 is preferably formed with a sharply pointed bottom end, much like a stake, such that it may be readily driven into the ground or other underlying support surface. Where the underlying support surface is overly hard, or is one which cannot be disturbed (paved surfaces, for example), alternate embodiments of pole portion 312 such as shown in FIG. 9 may be employed. In that alternate embodiment, pole portion 1312 is mounted at its bottom to a base structure 1314 which permits pole portion 1312 to remain freestanding. This base structure 1314 may include an extension 1316 configured to extend to - and pass beneath, if necessary - the bottom-most retention unit 200 of the given

barrier section. A bent termination 1318 extends upward from extension 1316 to bear against a side of that retention unit 200. Bent termination 1318 may be fastened, if necessary, to the retention unit surface for greater security of coupling. Pole portion 1312 is thereby maintained at a fixed distance from the given retention unit 200.

Where appropriate, a rib or some other vertically protruding formation may be included intermediately on extension 1316 spaced from bent termination 1318. This formation and bent termination 1318 would be spaced by the retention unit's thickness, so as to snugly and securely receive an edge portion of that retention unit.

Turning now to FIGS. 5-6, there is shown in greater detail the exemplary embodiment of retention unit 200 illustrated in FIGS. 1-2. Retention unit 200 includes a plank member 210 preferably formed with a longitudinally extended board-like contour defining a pair of opposed engagement portions 212 and an intermediate portion 214 extending longitudinally therebetween. Plank member 210 may be formed with any suitable dimensional configuration, so long as the engagement portions 212, at least, are dimensioned in thickness to engage the elongate channels of the support unit engagement sections in smoothly slidable manner.

In the embodiment shown, each plank member 210 is formed of a wooden material, but it may be formed of any other suitable material known in the art. Preferably, plank members 210, as well as other parts of retention unit 200, are formed of a liquid-impervious material that is of sufficient strength, rigidity, and durability to withstand repeated and extended periods of contact with risen waters

and water-borne debris, without excessive deflection, deformation, or compositional degradation. Preferably, the material used is also of sufficient density such that it is not overly buoyant yet not so heavy to hinder convenient handling. It is important in various implementations of the present invention that the components of the subject reconfigurable barrier system 10 be sufficiently portable and readily manipulable for quick and convenient assembly/disassembly. While various materials other than that shown, such as plastic, metal, composite, and other materials of suitable properties may be employed for plank member 210, the actual choice of material is to be made in light of the dimensional and other configurational constraints bearing on the intended application.

Each retention unit 200 includes in addition to a plank member 210 a seal portion 220 extending along at least the longitudinal edge of that plank member 210. In the embodiment shown, seal portion 220 is realized in the form of a rubber or other liquid impervious and resilient strip which engages an abutting surface - either a longitudinal edge of another plank member 210 or the supporting surface itself. This minimizes the seepage of water or other liquid between or beneath a barrier section's retention units 200.

The resilient strip embodiment of seal portion 220 may be realized with any other suitable configuration known in the art. In certain applications, a plurality of retention units 200 may be employed in edge-to-edge stacked manner, with the bottom-most retention unit 200 extending along an uneven ground surface. It may be suitable in such cases to employ in the bottom-most retention unit 200B a plank member 210B having a more substantial seal portion 220B specifically configured to ensure adequate conformity with the uneven ground

surface beneath it while maintaining a proper sealing effect, such as illustrated in FIG. 6B. As they would engage a relatively uniform upper edge of another retention unit 200, it may be sufficient to equip the other retention units 200 with simply a weather-strip like resilient member to provide an adequately conformed seal against the upper longitudinal edge of the plank member 210 below. Alternatively, some or all of the other retention units 200A may be formed as shown in FIG. 6A with a seal portion 220A having a side-offset flap configuration which provides an overlapping flap cover over the direct edge-to-edge junction of the stacked plank members 210A of retention units 200A. The flap in this embodiment - like the various seal portion components in other embodiments - may be coupled to their plank members by any suitably secure means known in the art.

In alternate embodiments such as illustrated in FIGS. 7-8, each retention unit 1200 may include a seal portion integrally formed with plank member 1210. As shown, one lateral edge of plank member 1210 may be formed with a longitudinally-extended protruding tongue 1222, and the other lateral edge of that plank member 1210 may be formed with a corresponding longitudinally-extended groove 1224. When edgewise stacked one over the other, an intimate tongue and groove engagement is realized between the stacked retention units 1200. The bottom-most retention unit 1200 may still be provided in such embodiments with an extraneous resilient seal portion much like the seal portion 220 shown in FIGS. 5-6, so as to ensure adequately conformed engagement of the underlaying support surface.

In the alternate embodiment of FIGS. 7-8, appropriately-shaped notches

may be formed in the respectively joined lateral edges of stacked retention units 1200 to cooperatively form an access opening 1230 to accommodate the passage of a brace unit tie member's arm portion 324 therethrough. Access opening 1230 may be formed with any configuration suited to the size and contour of tie member arm portion 324; and, supplemental seal measures (such as O-rings, resilient flaps, and the like) may be suitably employed as necessary to minimize the seepage of water or liquids through access opening 1230.

Referring back to FIGS. 1-2, the intercoupling of components in system 10 may be further secured by fixing one or more retention units 200 to their support units 100. This may be accomplished by simply applying a screw or other type of extraneous fastening measure (not shown) to corresponding portions of the support unit engagement sections 110 and the retention unit engagement portions held therein.

Such extraneous fastening measures are obviated by the alternate embodiment shown, for example, in FIGS. 10A-10B. In the embodiment there shown, each retention unit 2200 includes a plank member 2210 formed at its engagement portions with one or more retention slots 2213, disposed preferably at both the inner and outer sides thereof. Each support unit 2100 is then formed with engagement sections 2110 defining elongate channels 2112. An elongate pair of opposed retention ribs 2113 are formed respectively on each engagement section's inner and outer faces 2111a, 2111b to protrude therefrom into elongate channel 2112. Retention ribs 2113 extend lengthwise along the inner and outer faces 2111a, 2111b, to serve effectively as tracks which the corresponding retention slots 2213 of retention unit 2200 slidably engage upon insertion of a

retention unit's engagement portion into the given channel 2112 of support unit 2100.

The exemplary retention unit 2200 is shown in FIG. 10A with multiple sets of retention slots 2213 spaced respectively at different distances from the terminal side edge of its plank member 2210 as shown. This enables the retention unit's use with any one of several differently sized support units 2100.

As mentioned in preceding paragraphs, the depth of each elongate channel defined by a support unit's engagement section may be varied depending on such factors as the given barrier section's retention unit span length. Longer span lengths, for instance, may necessitate deeper channels 2112, hence wider inner and outer faces 2111a, 2111b, to ensure sufficiently secure intercoupling of a retention unit 2200 to support unit engagement section 2110. The same retention unit 2200 may then be used with any one of several support units 2100 having different-sized engagement portions 2110 - whose retention ribs 2113 are displaced from intermediate section 2120 by different extents.

Although this invention has been described in connection with specific forms and embodiments thereof, it will be appreciated that various modifications other than those discussed above may be resorted to without departing from the spirit or scope of the invention. For example, equivalent elements may be substituted for those specifically shown and described, certain features may be used independently of other features, the numbers and arrangement of certain features may be varied from that shown and described, and in certain cases, various features may be reversed or interposed, all without departing from the spirit or scope of the invention as defined in the appended claims.